

Name _____

Unit 1 Exam

AP Biology

2017 - 2018

This exam will be returned to you so be sure to annotate it while testing so you can understand any misconceptions when it is returned to you for review.

There are 10 multiple choice questions and 2 free response questions.

The exam must be completed within the class period

1. Two populations of a species of squirrel are geographically isolated from each other. Although they have the same population density, one population is significantly larger in number than the other. A new bacterial disease, which is easily spread and extremely virulent, affects both populations at the same time.

Which of the following is the best prediction of how the new disease will affect the two populations?

- (A) The two populations will be equally affected, because the ability to trigger an immune response is randomly distributed among all squirrels of that species.
- (B) The larger population will be less affected by the disease than will the smaller population, because the mutation rate of the larger population is higher than the mutation rate of the smaller population.
- (C) The smaller population will be more affected than will the larger population, because the smaller population has less genetic variation than the larger population has.
- (D) The smaller population will be less affected than will the larger population, because the smaller population exhibits more genetic drift than the larger population exhibits.

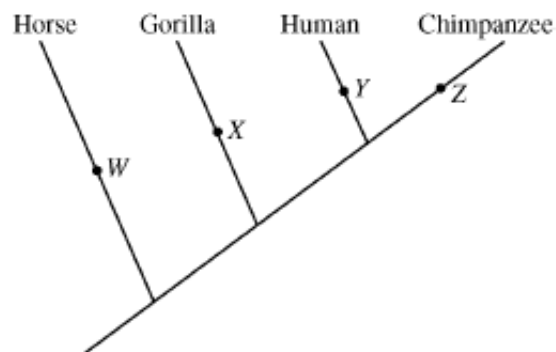
2.

Year	Population 1		Population 2	
	Allele <i>R</i>	Allele <i>r</i>	Allele <i>R</i>	Allele <i>r</i>
1980	0.3	0.7	0.37	0.63
2010	0.0	1.0	0.75	0.25

The table shows the changes in allele frequencies of a specific gene in two populations of randomly mating small mammals after 30 years. The populations inhabit adjacent equatorial islands that have similar topography and climate. Which of the following is the most reliable conclusion that can be drawn from analysis of the data above?

- (A) Genetic drift has occurred in population 1.
- (B) Population 2 is in Hardy-Weinberg equilibrium.
- (C) Selection for allele *r* is occurring in both populations.
- (D) The reduced frequency of allele *R* in population 1 will eventually lead to the extinction of population 1.

3. The cladogram shown below depicts an accepted model of the evolutionary relationships among selected species.



The amino acid at position 104 in the beta-hemoglobin protein for each of these four organisms is listed below.

Species	Amino Acid 104
Horse	Arginine
Gorilla	Leucine
Human	Arginine
Chimpanzee	Arginine

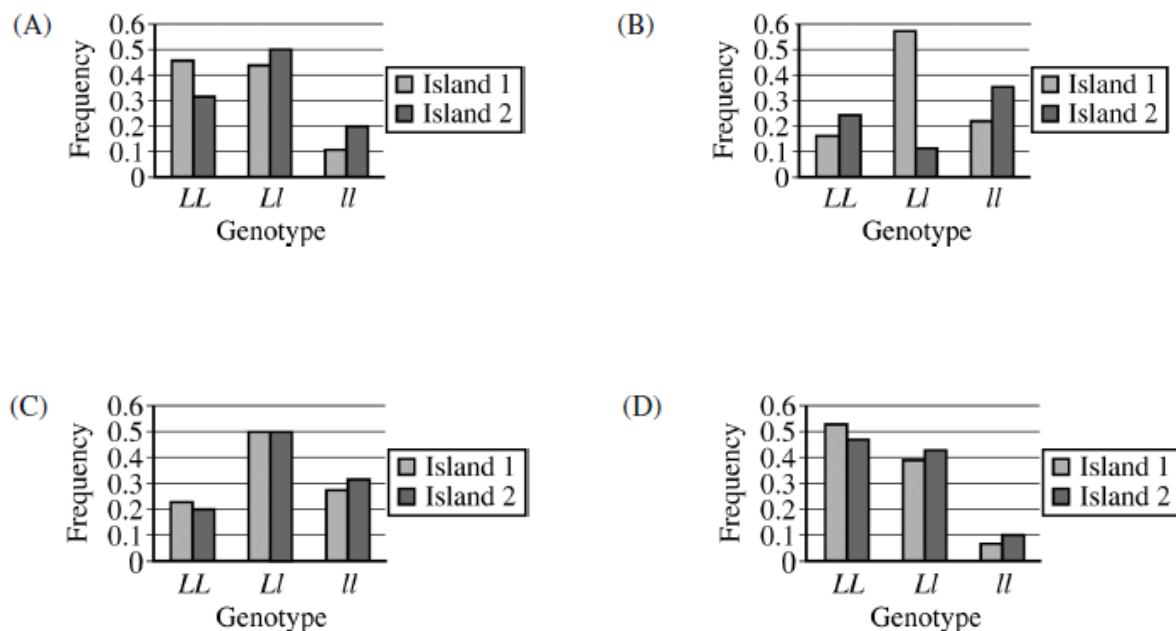
The validity of the cladogram is best supported by molecular evidence for which of the following changes in the amino acid composition of the beta-hemoglobin protein during the evolution of these species?

- (A) Arginine to leucine at position *X* on the cladogram
- (B) Arginine to leucine at position *Y* on the cladogram
- (C) Leucine to arginine at position *W* on the cladogram
- (D) Leucine to arginine at position *Z* on the cladogram

4. Scientists are studying several populations of finches on neighboring islands in the South Pacific. Previous genetic analysis has shown that a single gene controls tail-feather length in the finch populations and that the allele for long tail feathers (L) is dominant to the allele for short tail feathers (l). On two separate islands, the scientists recorded the number of finches with long tail feathers and the number of finches with short tail feathers. The results are shown in the table below.

Location	Phenotype	Number of Individuals
Island 1	Long tail feathers	1,582
	Short tail feathers	598
	Total count	2,180
Island 2	Long tail feathers	2,432
	Short tail feathers	1,110
	Total count	3,542

If the two finch populations are each in Hardy-Weinberg equilibrium and are isolated from each other, then which of the following graphs correctly displays the relative genotype frequencies?



Diapause is the interruption of an organism's life cycle in response to environmental cues. The soil nematode *Caenorhabditis elegans* is capable of entering adult reproductive diapause (ARD) when food is scarce. In *C. elegans*, individuals normally become reproductively mature 2 days after hatching and remain fertile for 18 days. They reproduce either by self-fertilization or by mating with another individual.

In an investigation, researchers examined the survival and reproductive success of *C. elegans* following different times in ARD. In the first experiment, groups of *C. elegans* were held in ARD without food for 0–30 days. Upon reintroduction of food, average brood sizes (average number of offspring per adult) were determined following either self-fertilization or mating with a well-fed male. The results are shown in Figure 1.

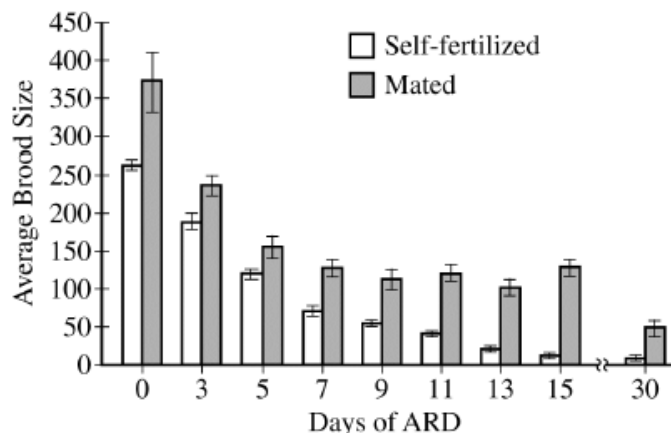


Figure 1. Mean brood sizes $\pm 2SE_{\bar{x}}$ after different times in ARD.

Individual *C. elegans* were held in ARD and subsequently allowed to reproduce either via self-fertilization (unshaded bars) or by mating with well-fed males (shaded bars).

In a second experiment, individuals were held in ARD without food for 0–30 days and monitored survival times following reintroduction of food (Figure 2).

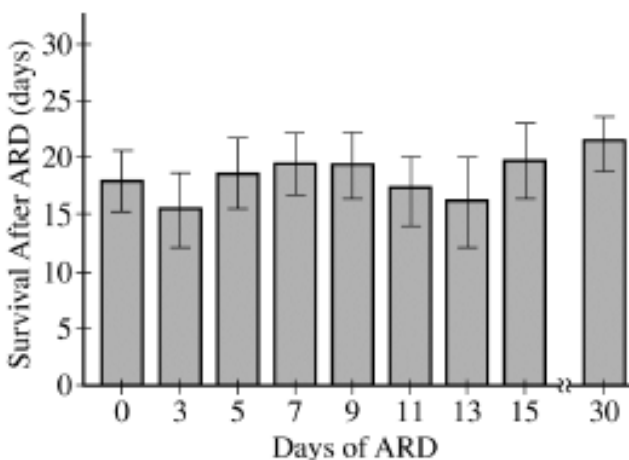


Figure 2. Mean survival $\pm 2SE_{\bar{x}}$ following different times in ARD.

Individual *C. elegans* were held in ARD and subsequently given access to food, whereupon their survival times were determined.

Use the information & figures on the previous page to answer questions 5 & 6.

5. Based on the experimental results, which of the following is the best evolutionary explanation for the occurrence of ARD in *C. elegans* ?
- (A) The ability to enter ARD provides a strong selective advantage because reproduction can occur despite periods of food scarcity.
 - (B) Acquiring the genes for ARD gives individuals a selective advantage because they produce more offspring than do individuals who cannot enter ARD.
 - (C) Individuals who can enter ARD are selected for in the population because they live longer than do individuals who cannot enter ARD.
 - (D) Individuals who can enter ARD have high fitness because they can reproduce even when food is scarce.
6. Which of the following conclusions is most consistent with the data shown in Figure 2 ?
- (A) Animals that spend 3–5 days in ARD are more likely to survive periods of food scarcity than are animals that spend 13–15 days in ARD.
 - (B) Animals that spend 30 days in ARD live significantly longer after reintroduction of food than animals that spend only 3 days in ARD.
 - (C) The number of days an animal spends in ARD does not significantly affect its time of survival after reintroduction of food.
 - (D) The large standard errors of the means make conclusions from the data impossible.

Use the information & figures 1-4 to answer questions 7-10 on the following page.

Over many generations, two populations of the same species can diverge into separate species through reproductive isolation. The figures below represent a model of speciation and show the results of matings between individuals from two diverging populations at four different stages of speciation. The males represented in the model are heterogametic, which means they have two different sex-determining chromosomes, (e.g., XY). The females are homogametic, which means they have two similar sex-determining chromosomes, (e.g., XX). The offspring from each mating are labeled interpopulation hybrids.

Figure 1 shows the results of a mating between a male and a female from the two populations. In each subsequent figure, the males are from one of the diverging populations and the females are from the other population. The fertility and viability of the offspring from each mating are indicated in the figures.

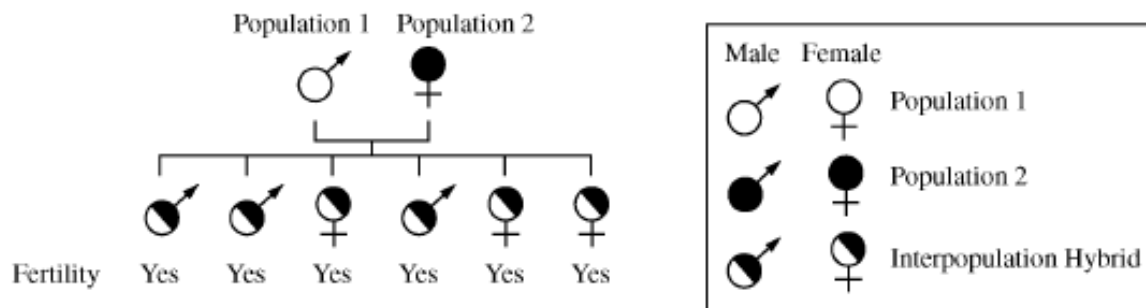


Figure 1. Mating between individuals from the initial populations

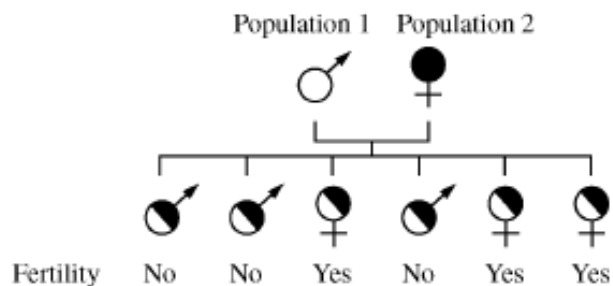


Figure 2. Mating between individuals from diverging populations at an intermediate stage of speciation

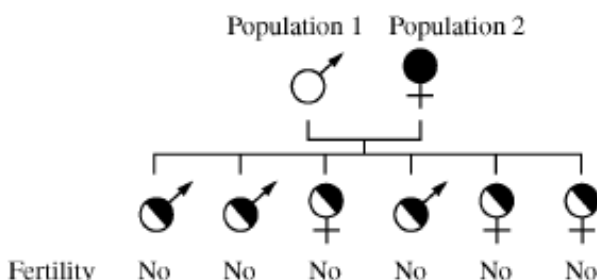


Figure 3. Mating between individuals from diverging populations at a late stage of speciation

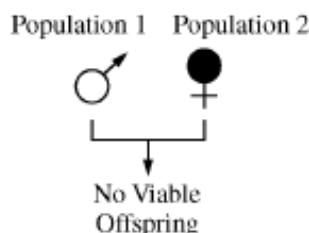


Figure 4. Mating between individuals from divergent populations after speciation is complete

7. Based on the model of speciation presented, which of the following describes the most likely consequence to the populations over time?
 - (A) Hybrid individuals are less likely to pass their genetic information on to subsequent generations.
 - (B) Hybrid individuals living together are physically unable to mate with each other.
 - (C) Geographically isolated populations gradually acquire similar heritable traits.
 - (D) Differences between hybrid individuals of a species disappear over time.
8. Which of the following best describes the reason for excluding hybrid males when calculating the allele frequencies of two interbreeding populations at the intermediate stage of speciation (Figure 2) ?
 - (A) The process of mate selection in large groups often favors females over males.
 - (B) The frequency of sex-determining chromosomes is usually equal to 0.5.
 - (C) Sterile individuals make no genetic contribution to the next generation.
 - (D) The chance of inheriting a recessive allele from a male is too small to calculate.
9. In a separate investigation, individual mice from two populations that in nature are geographically isolated from each other are mated in the laboratory. The hybrid offspring were then mated with individuals from either of the original populations. Only the female hybrid offspring were fertile. The experimental results are most consistent with which of the stages that are depicted in the model?
 - (A) Initial population (Figure 1)
 - (B) Intermediate stage (Figure 2)
 - (C) Late stage (Figure 3)
 - (D) Terminal stage (Figure 4)
10. Using the model of speciation and applying it to a different population, which of the following outcomes is most consistent for a different species in which the males are homogametic and the females are heterogametic?
 - (A) Sterility would appear in females before appearing in males.
 - (B) Speciation would occur more rapidly because females would produce more offspring.
 - (C) Behavioral isolation would occur sooner in species exhibiting nonrandom mating.
 - (D) The population would reach Hardy-Weinberg equilibrium at an accelerated rate.

Free Response Section

1. The table below compares several features among a prokaryote & a eukaryote organism that are both photosynthetic.

	Prokaryote	Eukaryote
First phase in metabolism of glucose	Glycolysis	Glycolysis
Location of enzymes for photosynthesis	Plasma membrane & cell cytoplasm	Chloroplast membranes & fluids
Location of photosynthetic genes	Cytoplasm on circular chromosome	Chloroplast on circular chromosome
Location of membrane protein genes	Cytoplasm on circular chromosome	Nucleus on numerous linear chromosomes
Membrane Structure	Double-membrane	Single-plasma membrane; double organelle membranes

- a. Explain how ONE feature in the table above provides evidence for the leading theory about the conditions on early Earth.
- b. Explain how THREE features in the table above provide evidence for the leading theory about the evolution of eukaryotes from prokaryotes.

2. Two populations of a parrot species were observed over the course of 10 years. The populations live on the same island within the same geographic range. The island is over 2,000 miles from the nearest mainland. Two varieties of colors were observed, a dominant red phenotype and a recessive blue phenotype. During the 10 year period there was no significant effect of color on survivorship. Several other pieces of data are documented in the table below.

	1990		2000	
	Population A	Population B	Population A	Population B
Red Phenotype	30%	30%	5%	31%
Blue Phenotype	70%	70%	95%	69%
Hybrid offspring viability of A x B crosses	98% hybrid offspring viability		12% hybrid offspring viability	

- Calculate** the percent change in the **red allele** from 1990 to 2000 for **population A**.
- For the 10 year period documented, **identify** a likely mechanism of evolution for population A and **identify** 2 mechanisms of evolution that are not likely occurring in population B.
- In 2001 a tourist accidentally lost its black mambas which prey upon blue birds in their native habitat. **Contrast** the effects of the predator on each parrot population's evolution over subsequent years.
- Propose** 2 possible mechanisms of reproductive isolation that could result in the decreased hybrid viability over the 10 year period documented.

